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UNITED STATES PATENT APPLICATION

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FOR

PROCESS FOR OBTAINING 17 α -ACETOXY-11 β -(4-N,N-DIMETHYLAMINO-PHENYL)-19-NORPREGNA-4,9-DIENE-3,20-DIONE

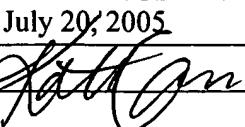
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CROSS-REFERENCE TO RELATED APPLICATIONS

- 25 This application is filed under the provisions of 35 U.S.C. §371 and claims the priority of International Patent Application No. PCT/ES2004/000026 filed January 21, 2004, which in turn claims priority of Spanish Patent Application No. P200300162 filed January 22, 2003.

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PROCESS FOR OBTAINING **17 α -ACETOXY-11 β -(4-N,N-DIMETHYLAMINOPHENYL)-19-NORPREGNA-4,9-DIENE-3,20-DIONE**

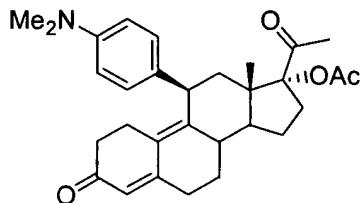
5 FIELD OF THE INVENTION

The invention relates to a process for obtaining 17 α -acetoxy-11 β -(4-N,N-dimethylaminophenyl)-19-norpregna-4,9-diene-3,20-dione from its isopropanol hemisolvate.

10 BACKGROUND OF THE INVENTION

Compound 17 α -acetoxy-11 β -(4-N,N-dimethylaminophenyl)-19-norpregna-4,9-diene-3,20-dione, hereinafter VA-2914, with formula

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20 is a known steroid with anti-progestational and anti-glucocorticoid activity which is useful in therapeutic and contraceptive gynaecological indications (uterine fibromas, endometriosis) and for treating Cushing syndrome and glaucoma. Said compound, as well as a process for obtaining it, is
25 described in US patent 4,954,490.

An alternative synthesis of VA-2914 is disclosed in US patent 5,929,262. The final product obtained by means of the process described in Example 7 of said US patent 5,929,262 is described as a product in the form of yellow crystals with a
30 melting point between 183°C and 185°C. The existence of said yellow colour indicates the presence of impurities, mainly phenol compounds.

It has now been found that VA-2914 isopropanol hemisolvate, which can be obtained with a high purity, is a useful intermediate in preparing VA-2914. Recrystallization of an appropriate solvent for said isopropanol hemisolvate, such as 5 ethanol/water or ethyl ether, gives a white coloured VA-2914, indicating the high degree of purity obtained.

Therefore, an aspect of the present invention is related to a process for obtaining VA-2914 comprising obtaining VA-2914 isopropanol hemisolvate and converting it into VA-2914.

10 In another aspect, the invention relates to said VA-2914 isopropanol hemisolvate, which has been identified and characterised by its infrared (IR) spectrum, its exotherm by differential scanning calorimetry (DSC) and its X-ray diffractogram (XRD). The isopropanol content (about 5.9%) in 15 said VA-2914 isopropanol hemisolvate was determined by gas chromatography and analysed by means of the internal standard technique.

In another aspect, the invention relates to a process for obtaining said VA-2914 isopropanol hemisolvate from VA-2914 and 20 isopropanol.

In another aspect, the invention relates to the use of said VA-2914 isopropanol hemisolvate in obtaining VA-2914 or in purifying raw VA-2914. The raw VA-2914 compound may be obtained by methods known in the state of the art. However, in a 25 particular embodiment, raw VA-2914 compound is obtained from compound 3,3-(1,2-ethanedioxy)-5 α -hydroxy-11 β -(4-N,N-dimethylaminophenyl)-17 α -acetoxy-19-norpregna-9-ene-20-one [carbinol acetate], which constitutes an additional aspect of this invention.

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BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a graph showing the infrared (IR) absorbance spectrum for the VA-2914 isopropanol hemisolvate crystalline form performed with a potassium bromide pellet in a Perkin Elmer 35 1600 Fourier Transform (FT_IR) IR spectrophotometer. Transmittance is shown on the Y axis and wave number on the X axis (cm^{-1}).

Figure 2 is a graph showing exotherm by differential scanning calorimetry (DSC) for the VA-2914 isopropanol hemisolvate crystalline form. The energy absorbed or transmitted per time unit (mW) is shown on the Y axis, and the temperature (C°) and time (minutes) are shown on the X axis.

Figure 3 is a graph showing the powder X-ray diffraction (XRD) spectrum of the VA-2914 isopropanol hemisolvate crystalline form obtained with a radiation source with a wavelength α_1 of 1.54060 Angstroms (Å), a wavelength α_2 of 1.54439 Å, an intensity ratio α_1/α_2 of 0.5, 40 kV voltage and 30 mA of current intensity, in Debye-Scherrer INEL CPS-120 equipment. The Y axis shows the pulses and in el X axis the angle 2θ.

Figure 4 is a graph showing the infrared (IR) absorbance spectrum of the VA-2914 crystalline form obtained by recrystallization in ethyl ether or in ethanol/water [US 5,929,262], performed with a potassium bromide pellet, in a Perkin Elmer 1600 Fourier Transform IR (FT_IR) IR spectrophotometer. Transmittance is shown on the Y axis and wave number on the X axis (cm⁻¹).

Figure 5 is a graph showing exotherm by differential scanning calorimetry (DSC) for the VA-2914 crystalline form obtained by recrystallization in ethyl ether or in ethanol/water [US 5,929,262]. The energy absorbed or transmitted per time unit (mW) is shown on the Y axis, and the temperature (C°) and time (minutes) are shown on the X axis.

Figure 6 is a graph showing the powder X-ray diffraction (XRD) spectrum of the VA-2914 crystalline form obtained by recrystallization in ethyl ether or in ethanol/water [US 5,929,262], obtained with a radiation source with a wavelength α_1 of 1.54060 Angstroms (Å), a wavelength α_2 of 1.54439 Å, an intensity ratio α_1/α_2 of 0.5, 40 kV voltage and 30 mA of current intensity, in Debye-Scherrer INEL CPS-120 equipment. The Y axis shows the pulses and in el X axis the angle 2θ.

Figure 7 is a graph showing exotherm by differential scanning calorimetry (DSC) for (i) the VA-2914 crystalline form obtained by recrystallization in ethyl ether or in ethanol/water

[US 5,929,262], and (ii) the VA-2914 isopropanol hemisolvate crystalline form. The energy absorbed or transmitted per time unit (mW) is shown on the Y axis, and the temperature (C°) and time (minutes) are shown on the X axis.

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DETAILED DESCRIPTION OF THE INVENTION

Obtaining VA-2914

In a first aspect the present invention provides a process for obtaining VA-2914 comprising its recrystallisation in isopropanol under conditions allowing obtaining, in an unequivocal and reproducible manner, a new VA-2914 crystalline form, specifically its isopropanol hemisolvate, useful as an intermediate in obtaining highly pure VA-2914.

More specifically, the process for obtaining VA-2914 provided by this invention comprises:

- a) forming VA-2914 isopropanol hemisolvate crystals by means of crystallising VA-2914 in isopropanol;
- 20 b) separating the VA-2914 isopropanol hemisolvate crystals; and
- c) converting the VA-2914 isopropanol hemisolvate into VA-2914.

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The VA-2914 compound can be obtained by means of any of the processes known in the state of the art [see, for example, US patent 4,954,490 and US patent 5,929,262]. However, in a particular embodiment, said VA-2914 can be obtained from compound 3,3-(1,2-ethanediyoxy)-5 α -hydroxy-11 β -(4-N,N-dimethylaminophenyl)-17 α -acetoxy-19-norpregna-9-ene-20-one, called carbinol acetate in this description, by means of a process comprising deprotecting the ketone and dehydrating said compound in order to obtain VA-2914, for example, by means of acid hydrolysis. In principle, any organic or inorganic acid capable of hydrolysing the cetal group and removing the hydroxyl

group present in position 5 can be used, for example, sulphuric acid, trifluoroacetic acid, monopotassium sulfate, etc.

VA-2914 isopropanol hemisolvate crystal formation by crystallising VA-2914 in isopropanol comprises previous 5 dissolution of VA-2914 in isopropanol and subsequent formation of said VA-2914 isopropanol hemisolvate crystals. Dissolution of VA-2914 in isopropanol is preferably carried out under heat, which facilitates its dissolution, and then the resulting solution is allowed to cool, optionally under stirring, so that 10 the VA-2914 isopropanol hemisolvate crystals form. In a particular embodiment, the VA-2914 and isopropanol mixture is heated at a temperature comprised between 75°C and the reflux temperature of the solvent, up to complete dissolution of VA-2914, and the solution of VA-2914 in isopropanol is subsequently 15 allowed to cool at a temperature comprised between 0°C and 30°C, which gives rise to VA-2914 isopropanol hemisolvate crystal formation.

Separation of VA-2914 isopropanol hemisolvate crystals can be carried out by any conventional method. In a particular 20 embodiment, the crystals obtained are separated by filtration.

Converting VA-2914 isopropanol hemisolvate into VA-2914 can be performed by any conventional method, for example, by recrystallization in a suitable solvent. In a particular embodiment, VA-2914 is obtained by recrystallising isopropanol 25 hemisolvate in a solvent chosen between ethanol/water and ethyl ether. VA-2914 thus obtained has been identified by its infrared (IR) spectrum, its exotherm by differential scanning calorimetry (DSC) and by its X-ray diffraction (XRD) diffractogram and the results obtained [see Figures 4-7] correspond to those of the 30 VA-2914 crystalline form obtained by recrystallization in ethyl ether or in ethanol/water, according to the process disclosed in US patent 5,929,262.

VA-2914 isopropanol hemisolvate

35 In another aspect, the invention provides a new VA-2914 crystalline form, specifically VA-2914 isopropanol hemisolvate,

a crystalline form that has been identified and characterised by IR spectroscopy, DSC and XRD.

This new VA-2914 crystalline form is an isopropanol hemisolvate, as has been verified by gas chromatography, and has 5 an isopropanol content of about 5.9% by weight [see Example 5].

VA-2914 isopropanol hemisolvate is characterised in that

it shows a potassium bromide pellet IR spectrum substantially similar to that shown in Figure 1, having 10 significant bands at 1684, 1660, 1609, 1595, 1560, 1543, 1513, 1476, 1458, 1438, 1394, 1364, 1353, 1317, 1303, 1260, 1235, 1214, 1201, 1168, 1137, 1089, 1076, 1063, 1042, 1015, 965, 949, 922, 863, 830, 822, 795, 771, 734, 699, 668, 642, 617, 608, 592, 574, 537, 495 and 467 cm⁻¹;

15 exotherm recording by DSC shows a peak at about 156°C, which corresponds with the endothermic melting phenomenon of said crystalline form at high temperatures (see Figure 2) [DSC recording was performed in a closed vessel, at a 20 temperature comprised between 10°C and 200°C, with a heating rate of 10°C/min, in Mettler Toledo Star System equipment]; and

25 it shows an X-ray diffraction (XRD) diffractogram (powder) substantially similar to that shown in Figure 3, with characteristic peaks at 8.860, 9.085 and 16.375 degrees 2θ, using a radiation source with a wavelength α_1 of 1.54060 Å, a wavelength α_2 of 1.54439 Å, a wavelength intensity ratio α_1/α_2 of 0.5, 40 kV voltage and 30 mA current intensity, in 30 Debye-Scherrer INEL CPS-120 equipment; more specifically, XRD analysis of said crystalline form (powder) shows the characteristics listed in Table 1.

Table 1

35 VA-2914 Isopropanol Hemisolvate XRD (Powder) Characteristics

2θ	$d \alpha_1$ (Å)	$d \alpha_2$ (Å)	Peak I. (counts)	Rel.I. (%)
9.085	9.7262	9.7501	10920	100.0
8.860	9.9727	9.9972	6131	56.1
16.375	5.4089	5.4222	5868	53.7
5 17.750	4.9929	5.0052	5388	49.3
18.720	4.7363	4.7480	4830	44.2

d: distance; Peak I.: Peak Intensity; Rel. I.: Relative Intensity

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IR, DSC and XRD study and characterisation of VA-2914 isopropanol hemisolvate and its comparison to corresponding analyses by IR, DSC and XRD of VA-2914 compound obtained by recrystallization in ethyl ether or in ethanol/water [US 5,929,262], has shown that said isopropanol hemisolvate is a new VA-2914 crystalline form.

The VA-2914 compound obtained by recrystallization in ethyl ether or in ethanol/water [US 5,929,262] shows the following characteristics:

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it shows a potassium bromide pellet IR spectrum substantially similar to that shown in Figure 4, having significant bands at 1684, 1661, 1611, 1595, 1560, 1542, 1517, 1499, 1458, 1438, 1390, 1364, 1350, 1304, 1253, 1236, 25 1202, 1167, 1147, 1077, 1064, 1023, 965, 952, 921, 867, 832, 809, 767, 699, 668, 615, 575, 540 and 495 cm^{-1} ;

exotherm recording by DSC shows a peak at 189°C, which corresponds with the endothermic melting phenomenon of said crystalline form at high temperatures (see Figure 5) [said DSC recording was performed in a closed vessel, at a temperature comprised between 10°C and 200°C, with a heating rate of 10°C/min, in Mettler Toledo Star System equipment]; and

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it shows an X-ray diffraction (XRD) diffractogram substantially similar to that shown in Figure 6, with

characteristic peaks at 9.110 and 16.965 degrees 2θ , using a radiation source with a wavelength α_1 of 1.54060 Å, a wavelength α_2 of 1.54439 Å, a wavelength intensity ratio α_1/α_2 of 0.5, 40 kV voltage and 30 mA current intensity, in Debye-Scherrer INEL CPS-120 equipment; more specifically, XRD analysis of said crystalline form shows the characteristics listed in Table 2.

Table 2

VA-2914 XRD (Powder) Characteristics

2θ	d α_1 (Å)	d α_2 (Å)	Peak I. (counts)	Rel. I. (%)
9.110	9.6996	9.7234	21054	100.0
16.965	5.2221	5.2350	13502	64.1
15.130	5.8511	5.8655	8705	41.3
15.010	5.8976	5.9121	8668	41.2
17.165	5.1617	5.1744	8263	39.2

d: distance; Peak I.: Peak Intensity; Rel. I.: Relative Intensity

Additionally, an exotherm recording by DSC was simultaneously performed for both crystalline forms [VA-2914 isopropanol hemisolvate and VA-2914 obtained by recrystallization in ethyl ether or in ethanol/water (US 5,929,262)]. The results obtained are shown in Figure 7, where it can be observed that said DSC recording shows 2 peaks, one at about 156°C, corresponding to the endothermic melting phenomenon of the VA-2914 isopropanol hemisolvate crystalline form at a high temperature, and another one at 189°C, corresponding to the endothermic melting phenomenon of the VA-2914 crystalline form obtained by recrystallization in ethyl ether or in ethanol/water (US 5,929,262), at a high temperature. DSC recording was performed in a closed vessel, at a temperature comprised between 10°C and 200°C, with a heating rate of 10°C/min, in Mettler Toledo Star System equipment.

IR spectroscopy has proven to be a very useful tool for differentiating between both crystalline forms given that very clear and characteristic bands occur for each one of them at

wavelengths in which no other band of the other crystalline form occurs. Thus, for example, the band occurring at 809 cm⁻¹ in the IR spectrum of the VA-2914 compound obtained by recrystallization in ethyl ether or in ethanol/water (US 5,929,262) [Figure 4] does not occur in the IR spectrum of VA-2914 isopropanol hemisolvate [Figure 1].

XRD powder characterisation of both crystalline forms [VA-2914 isopropanol hemisolvate and VA-2914 obtained by recrystallization in ethyl ether or in ethanol/water (US 10 5,929,262)] is significantly different, which shows the existence of two different crystalline forms. As is known, X-Ray studies form the best tool for differentiating between two crystalline forms given that each crystalline form has different and characteristic diffractions, and, therefore, each form can 15 be unequivocally identified. The simple comparison of the XRDs for said crystalline forms shows that there are diffractions in one of the crystalline forms which fall in an area where there are no diffractions of the other crystalline form [sees Figures 3 and 6, and Tables 1 and 2]

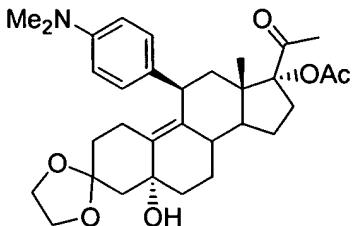
20 The previously mentioned data confirms that the VA-2914 isopropanol hemisolvate provided by this invention is a new crystalline form, different to the VA-2914 crystalline form obtained by recrystallization in ethyl ether or in an ethanol/water mixture, according to the process described in US 25 patent 5. 929.262.

VA-2914 isopropanol hemisolvate can be obtained by means of a process comprising dissolving VA-2914 in isopropanol under heat, for example, at a temperature comprised between 75°C and the solvent reflux temperature, and allowing the resulting 30 solution to cool down to a temperature comprised between 0°C and 30°C. This VA-2914 crystalline form can be used as an intermediate in obtaining highly pure VA-2914 or in purifying raw VA-2914.

Carbinol acetate

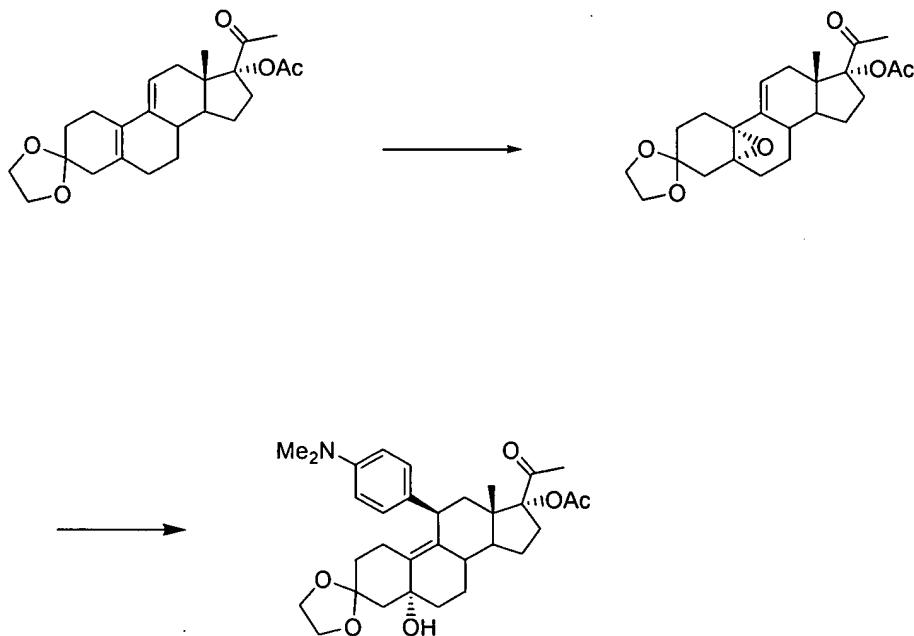
Compound 3,3-(1,2-ethanedioxy)-5 α -hydroxy-11 β -(4-N,N-dimethylaminophenyl)-17 α -acetoxy-19-norpregna-9-ene-20-one, called carbinol acetate in this description, with formula

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is a new compound, useful in synthesising VA-2914, and constitutes an additional aspect of the present invention.

10 Carbinol acetate can be obtained by means of a process such as that shown in the following Reaction Scheme.



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Briefly, obtaining carbinol acetate comprises, in a first step, epoxidising the double bond 5(10) present in 17 α -acetoxy-

3,3-(1,2-ethanedioxy)-19-norpregna-5,(10),9(11)-diene-20-one by means of reacting said compound with an adduct formed by reaction of a halogenated ketone and a peroxide, in the presence of a base and a solvent. Said halogenated ketone can be a 5 halogenated acetone, for example, hexafluoroacetone or hexachloroacetone. Any suitable peroxide can be used in this reaction, for example, hydrogen peroxide, an alkaline metal peroxide, a peroxyacid, etc. This epoxidation reaction is carried out in the presence of a base, preferably of an 10 inorganic base, such as, for example, a phosphate, an alkaline metal carbonate or bicarbonate and an organic solvent, preferably a halogenated solvent. In a particular embodiment, the halogenated ketone hexafluoroacetone, the peroxide is hydrogen peroxide, the base is dibasic sodium phosphate and the 15 solvent is dichloromethane.

The epoxide obtained is then reacted in a second step with a Grignard reagent, such as 4-N,N-dimethylaminophenylmagnesium bromide in the presence of a Cu(I) salt in order to obtain carbinol acetate.

20 The following Examples illustrate the invention and must not be considered to be limiting thereof.

EXAMPLE 1

Obtaining raw 17 α -acetoxy-11 β -(4-N,N-dimethylaminophenyl)-19-norpregna-4,9-diene-3,20-dione [VA-2914]

25 38.5 g of purified 3,3-(1,2-ethanedioxy)-5 α -hydroxy-11 β -(4-N,N-dimethylaminophenyl)-17 α -acetoxy-19-norpregna-9-ene-20-one [carbinol acetate] were loaded into a flask under nitrogen atmosphere at a temperature comprised between 20°C and 22°C, and 30 385 ml of deionised water and 17.91 g of HKSO₄ were added. The obtained suspension was stirred until complete dissolution, for about 4 hours. The end of the reaction was determined by means of thin layer chromatography (TLC).

35 3.85 g of neutral Al₂O₃ were then added, it was stirred for 30 minutes, the suspension was filtered and the insoluble particles were washed with 38.5 ml of deionised water. 325 ml of ethyl acetate were added to the filtrates and the pH was

adjusted to a constant value between 7.0 and 7.2 with 7% w/v sodium bicarbonate solution. The phases were allowed to decant for 15 minutes and, after verifying the absence of the final product therein by means of TLC, the phases were separated,
5 discarding the aqueous phase.

192.5 ml of deionised water were added to the resulting organic phase, it was stirred for 10 minutes and the phases were allowed to decant for 15 minutes. After verifying the absence of the final product in the aqueous phase by means of TLC, the
10 phases were separated, discarding the aqueous phase.

The resulting organic phase was vacuum-concentrated until obtaining a residue and about 28 g of raw 17 α -acetoxy-11 β -(4-N,N-dimethylaminophenyl)-19-norpregna-4,9-diene-3,20-dione [VA-2914] were obtained.

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EXAMPLE 2

Obtaining 17 α -acetoxy-11 β -(4-N,N-dimethylaminophenyl)-19-norpregna-4,9-diene-3,20-dione isopropanol hemisolvate

2 x 38.5 ml of isopropanol vacuum-concentrated to a residue
20 both times were added to the raw 17 α -acetoxy-11 β -(4-N,N-dimethylaminophenyl)-19-norpregna-4,9-diene-3,20-dione obtained in Example 1. 77 ml of isopropanol were added to the obtained solid and it was heated until dissolution. It was then allowed to cool to a temperature comprised between 0°C and 5°C, and the
25 temperature was maintained for 1 hour. The obtained suspension was filtered and the cake was washed with cold isopropanol. The yield achieved was 96% molar (5.5% isopropanol content).

The VA-2914 isopropanol hemisolvate obtained was characterised by IR spectroscopy, DSC and XRD, as indicated in
30 the description, and has the characteristics indicated therein and shown in Figures 1-3.

EXAMPLE 3

Converting 17 α -acetoxy-11 β -(4-N,N-dimethylaminophenyl)-19-norpregna-4,9-diene-3,20-dione isopropanol hemisolvate into VA-
35 2914

10 g of VA-2914 isopropanol hemisolvate were suspended under stirring in 100 ml of an ethanol/H₂O (80/20) mixture. The suspension is heated until dissolution and once the product is dissolved said solution is cooled at 15-20°C. The crystals obtained are separated by filtration and the product is dried in a vacuum oven until achieving a constant weight. 7.5 g are obtained of VA-2914 of the desired crystalline form, which has been characterised by IR spectroscopy, DSC and XRD, and shows the characteristics of the VA-2914 compound obtained by recrystallization in ethyl ether or in ethanol/water (US 5,929,262) and shown in Figures 4-6, are obtained.

EXAMPLE 4

Obtaining 3,3-(1,2-ethanedioxy)-11β-(4-N,N-dimethylaminophenyl)-17α-acetoxy-19-norpregna-9-ene-20-one [Carbinol acetate]

Step 1:

Synthesising 17α-Acetoxy-3,3-(1,2-ethanedioxy)-5,10α-epoxy-19-norpregna-9(11)-ene-20-one

14.82 g of 17α-acetoxy-3,3-(1,2-ethanedioxy)-19-norpregna-5,(10),9(11)-diene-20-one (37 mmol) are dissolved in 220 ml of Cl₂CH₂ and the resulting solution is cooled at 0°C. 3.15 g of Na₂HPO₄ (22.24 mmol), 3.1 ml of hexafluoroacetone (22.24 mmol) and 5.3 ml of 50 % H₂O₂ (91.9 mmol) are added. The mixture is heated at room temperature and is stirred overnight. The reaction is hydrolysed with a saturated solution of NaHCO₃ and it is extracted 3 times with Cl₂CH₂. The pooled organic phases are dried with Na₂SO₄ and vacuum-concentrated until completely eliminating the solvent. A yellow solid is obtained with a quantitative yield. The raw solid obtained is a 4:1 mixture of the 9(10) α and β epoxy isomers. The crude obtained is used in the following step without purifying.

Step 2

Synthesising 3,3-(1,2-Ethanedioxy)-5α-hydroxy-11β-(4-N,N-dimethylaminophenyl)-17α-acetoxy-19-norpregna-9-ene-20-one

The residue from the previous step is dissolved in 150 ml of dry THF under nitrogen atmosphere and 4.2 g of ClCu are

added. The suspension is cooled at 0°C and 92.5 mmol of a solution of 4-N,N-dimethylaminophenylmagnesium bromide in freshly prepared THF are added. After 10 minutes the mixture is hydrolysed with 200 ml of a saturated solution of NH₄Cl, the 5 mixture is stirred for 5 minutes at room temperature and the phases are decanted. The resulting organic phase is vacuum-concentrated until eliminating all the solvents. The obtained residue is purified by column chromatography and 12.5 g (63.0 %) of the title compound are obtained.

10

¹H NMR (400 MHz, CDCl₃) δ 7.0 (dd, 2, ArH), 6.62 (dd, 2, ArH), 4.41 (s, 1, -OH, C₅) 4.28 (d, 1, CH, C₁₁), 3.9 (m, 4, cetal (CH₂)₂, C₃), 2.85 (s, 6, -N(CH₃)₂), 2.12 (s, 3, CH₃, C₂₀), 2.07 (s, 3, acetate CH₃, C₁₇), 0.25 (s, 3, CH₃, C₁₈).

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EXAMPLE 5

Determining isopropanol content in 17α-acetoxy-11β-(4-N,N-dimethylaminophenyl)-19-norpregna-4,9-diene-3,20-dione isopropanol hemisolvate

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Determining isopropanol content in 17α-acetoxy-11β-(4-N,N-dimethylaminophenyl)-19-norpregna-4,9-diene-3,20-dione (VA-2914) isopropanol hemisolvate was performed by means of gas chromatography in a 5% phenyl methyl silicone column (30 m), using nitrogen as a carrier gas.

25

Isopropanol detection was carried out by means of flame ionisation; at an isothermal oven temperature of 65°C. Detector temperature was 300°C and injector temperature was 250°C.

30

Analysis was carried out by means of the internal standard technique. To this end a solution with a concentration of 50 mg of dioxane per ml of dimethylformamide (DMF) ["Internal STD Solution"] was prepared. A solution of 50 mg of isopropanol/ml of DMF was prepared as a "Standard Preparation". 1 ml of each one of the previous solutions ("Internal STD Solution" and "Standard Preparation") were then taken and diluted to a volume 35 of 10 ml with DMF.

To carry out this test, 1 g of VA-2914 isopropanol hemisolvate was weighed, 1 ml of the "Internal STD Solution" was

added and it was diluted to a volume of 10 ml with DMF ("Test Preparation").

The "Test Preparation" and the "Standard Preparation" were injected in the gas chromatographer and the isopropanol content 5 in the VA-2914 isopropanol hemisolvate sample was calculated by means of the internal standard technique. The isopropanol content is 5.9%, which corresponds to the theoretical amount for a VA-2914 isopropanol hemisolvate.